Chapter 7. San Joaquin River Hydrologic Region

Setting

The San Joaquin River Hydrologic Region is in the heart of California and includes the northern portion of the San Joaquin Valley. It is bordered on the east by the Sierra Nevada and on the west by the coastal mountains of the Diablo Range. It extends from the southern boundaries of the Sacramento – San Joaquin Delta to include all of the San Joaquin River drainage area to the northern edge of the San Joaquin River in Madera. Roughly half of the Sacramento – San Joaquin Delta overlay region lies in this hydrologic region, encompassing those portions of the Delta in Contra Costa, Alameda, and San Joaquin counties. The region extends south from just below the northeastern corner of Sacramento County and east to include the southern third of El Dorado County, almost all of Amador County, all of Calaveras, Mariposa, Madera, Merced, Stanislaus, and Tuolumne counties, and the western slope of Alpine County. The San Joaquin River Basin is hydrologically separated from the Tulare Lake Basin by a low, broad ridge across the trough of the San Joaquin Valley between the San Joaquin and Kings rivers. A map and table of statistics describing the region are presented in Figure 7-1.

One of the state's longest rivers at 300 miles, the San Joaquin's average unimpaired runoff is about 1.8 million acre feet per year. The San Joaquin River and its eight major tributaries drain about 32,000 square miles. The headwaters of the San Joaquin River begin nearly 14,000 feet elevation at the crest of the Sierra Nevada. The river runs west down the mountains and foothills, and then flows northwest to the Delta where it meets the Sacramento River. The two rivers converge in the 1,153-square-mile Sacramento-San Joaquin Delta—a maze of channels and islands—which also receives fresh water inflow from the Cosumnes, Mokelumne and Calaveras rivers and other smaller streams. Historically, more than 40 percent of the state's run-off flowed to the Delta via the Sacramento, San Joaquin and Mokelumne rivers.

Climate

Because the San Joaquin Valley is isolated by mountains from the marine effects of coastal California, the average daily maximum summer temperature in the valley advances to a high of 101 degrees during the late July. The daily maximum temperature during this warmest month has ranged from 76 to 115 degrees. The northern part of this hydrologic region does benefit from Delta breezes during the hotter summer periods, typically as consistent winds driven by the strong temperature difference between hot valley temperatures and cooler marine temperatures in the San Francisco Bay Area. Winter temperatures in the valley floor regions are usually mild but during infrequent cold spells minimum readings occasionally drop below freezing. Heavy frost occurs in most falls and winters, typically between the end of November and early March.

The San Joaquin Valley experiences a range of climate and precipitation, which varies from lesser amounts on the valley floor to medium rainfall amounts in the foothills, and to extensive amounts of snow in the higher elevations of the Sierra Nevada. The climate of much of the upland area west of the valley resembles that of the Sierra foothills. The average annual precipitation of several Sierra Nevada stations is about 35 inches. Snowmelt runoff from the mountains is the major contributor to local water supplies for the eastern San Joaquin Valley. The climate of the valley is characterized by long, hot summers and mild winters, and average annual precipitation ranges from about 22.5 inches near the Sacramento area in the northeast to about 11.1 inches in the southern portion of the region while decreasing to 6.5 inches near the drier southwestern corner of the region.

Population

The population of the San Joaquin River region in year 2000 was about 1.7 million, which was about 5 percent of the state's total population. Although there are 15 counties partially or entirely in the San Joaquin River region, most of the population and agricultural land use occurs in five counties: San Joaquin, Stanislaus, Merced, Contra Costa, and Madera. Of these, the county with the largest population was San Joaquin County with 567,600. Stockton, its largest city, had 243,771 inhabitants. The city of Modesto, in Stanislaus County, the second largest county at 450,900, had a population of 188,856. The largest city in Merced County, with a population of 210,200, was Merced, with a population of 63,800. Contra Costa County had 145,775 residents inside the San Joaquin River region; the largest population was in the city of Antioch, where about 78,000 people lived in the regional boundaries. Finally, the city of Madera has a population of 46,100, while Madera County has a population of 127,400. Figure 7-2 provides a graphical depiction of the San Joaquin region's total population from year 1960 through year 2000, with current projections to year 2030.

California experienced a population increase approaching 4 percent from 1990 to 2000, and the growth rates in San Joaquin valley cities and counties are exceeding this trend. According to California Department of Finance projections, growth rates for the above four counties will range between 18 and 32 percent over the next 10 years. The highest rate of urbanization will occur in the northern portion of the region. For San Joaquin County, projected populations will increase to 747,100 by 2010 and to 1,229,000 by 2030. Similarly, the projected population for Stanislaus County will increase to 559,100 by 2010, and to 744,600 by 2030. The ongoing rapid rate of urbanization in these regions will generate significant land and water uses challenges for the entire San Joaquin Valley.

Land Use

The valley portion of the San Joaquin region consists primarily of highly productive farmland and rapidly growing urban areas of Stockton, Tracy, Modesto, Manteca, and Merced. Agriculture is the major economic and land use activity in the San Joaquin River region. The San Joaquin Valley ranks among the most important agricultural regions in California, with roughly 2 million acres of irrigated cropland and an annual output valued at more than $ 4.9 billion. Irrigated acreage is very diversified with about 34 percent planted to permanent crops and 29 percent to grains, hay and pasture. Some of the other major crops include cotton, corn, tomatoes, and other field and truck crops. In addition to agriculture, other important industries in the region include food processing, chemical production, lumber and wood products, glass, textiles, paper, machinery, fabricated metal products and various other commodities. About 2,050,400 or 21 percent of the region's 9,737,200 acres were devoted to irrigated agriculture in 2000.

While the San Joaquin Valley is mostly privately owned agricultural land, much of the Sierra Nevada is national forest. These mountains on the east side of the valley include the Eldorado, Stanislaus, and Sierra National Forests and the Yosemite National Park. Public lands amount to about one-third of the region. The national forest and park lands encompass more than 2.9 million acres; state parks and recreational areas and other State property account for about 80,000 acres; and U.S. Bureau of Land Management and military properties occupy over 200,000 and 5,100 acres, respectively. The valley portion of the region constitutes about 3.5 million acres, the eastern foothills and mountains total about 5.8 million acres, and the western coastal mountains comprise about 900,000 acres.

The restoration of Central Valley wetlands habitat is critical to the preservation of many species of fish and wildlife in the San Joaquin River ecosystem. Beginning in the 1990s, agencies began to make progress in efforts to set aside and restore acreage for wetland habitat. In 1990, the San Joaquin River Management Program was formed to restore the river system, which led to completion of the San Joaquin River Management Plan in 1995. This plan identified nearly 80 consensus-based actions intended to benefit the San Joaquin River system, which are organized into the categories of projects, feasibility studies and riparian habitat acquisitions. Many federal and State agencies now have active roles in the funding and implementation of wetlands habitat restoration programs, including the U.S. Fish and Wild Service, the California Bay-Delta Authority and the California Department of Fish and Game. One of the larger projects along the San Joaquin River is the restoration of 775 acres of native riparian habitat on the West Unit of the San Joaquin River National Wildlife Refuge, west of Modesto. About 158,000 native trees, shrubs and vines will be planted to accommodate the habitat needs of threatened and endangered species.

The San Joaquin Valley serves as a breeding and resting ground along the Pacific Flyway for many species of waterfowl. Public wildlife refuges in the San Joaquin River region that support this habitat need include the San Luis National Wildlife Refuge, 26,340 acres; San Joaquin River National Wildlife Refuge, 2,875 acres; Merced National Wildlife Refuge, 8,280 acres; Los Banos Wildlife Area, 5,310 acres; Volta Wildlife Area, 2,180 acres; the North Grasslands Wildlife Area, 2,160 acres; the White Slough Wildlife Area, 969 acres; and the Isenberg Sandhill Crane Reserve, 361 acres. Toward the northern end of this region, the Cosumnes River Preserve is managed by the Nature Conservancy and has now become the largest refuge area in the region at 36,300 acres.

Water Supply and Use

The primary sources of surface water in the San Joaquin River region are the rivers that drain the western slope of the Sierra Nevada. These include the San Joaquin River and its major tributaries, the Merced, Tuolumne, Stanislaus, Calaveras, Mokelumne, and Cosumnes rivers. Most of these rivers drain large areas of high-elevation watershed that supply snowmelt runoff during the late spring and early summer. Other tributaries to the San Joaquin River, including the Chowchilla and Fresno rivers, originate in the Sierra Nevada foothills, where most of the runoff results from rainfall.

In 2000, an average water year, about 44 percent of the San Joaquin region's developed water supply came from local surface sources, 23 percent was from imported surface supplies, and groundwater provided about 33 percent of the water supply. About 26 percent of the developed supply, excluding surface and groundwater reuse, was considered dedicated natural flows for meeting instream flow requirements. Figure 7-3 provides a graphical presentation of all of the water supply sources that are used to meet the developed water uses in the region for 1998, 2000 and 2001.

Surface water supply systems in the Sierra streams and rivers form a general pattern. A series of small reservoirs in the mountain valleys gathers and stores snowmelt. This water is used to generate electricity as it is released downstream. Some diversions occur for consumptive use in local communities, but most flows are recaptured in larger reservoirs in the foothills and along the eastern edge of the valley. Most of these reservoirs were built primarily for flood control; however, many of them also have additional storage for water supply and other uses included in their design. Irrigation canals and municipal pipelines divert much of the water from or below these reservoirs. Most of the small communities in the Sierra foothills receive much of their water from local surface supplies. The extensive network of canals and ditches constructed in the 1850s for hydraulic mining forms the basis of many of the conveyance systems. In addition to surface water, many of these mountain communities pump groundwater from hard rock wells and old mines to augment their supplies, especially during droughts. Groundwater is the only source for many mountain residents who are not connected to a conveyance system.

On the valley floor, many agricultural and municipal users receive their water supply from large irrigation districts, including Modesto Irrigation District, Merced, Oakdale, South San Joaquin and Turlock Irrigation districts. Most of this region's imported supplies, about 1.9 million acre feet per year, are delivered by the federal Central Valley Project. Oak Flat Water District receives about 4,500 acre feet per year from the State Water Project.

Most of the water in the upper San Joaquin River is diverted at Friant Dam, and is conveyed north through the Madera Canal and south through the Friant-Kern Canal. Average annual diversions from the San Joaquin River through the Friant-Kern and Madera Canals are about 1.5 million acre feet. Releases from Friant Dam to the San Joaquin River are generally limited to those required to satisfy downstream water rights, above Gravelly Ford, and for flood control. In the vicinity of Gravelly Ford, high channel losses to the ground water basin occur because the river bed is primarily sand and gravel. Due to the operation of Friant Dam, there are seldom any surface flows in the lower San Joaquin River except for flows originating in the major downstream tributaries plus agricultural and municipal return flows.

The tributaries of the San Joaquin River provide the San Joaquin River region with high-quality water and most of its surface water supplies. Most of this water is regulated by reservoirs and used on the east side of the valley. Some water is diverted west across the valley to the Bay Area via the Mokelumne Aqueduct, which supplies some for the urban water demands of East Bay Municipal Utility District, and the Hetch Hetchy Aqueduct, which supplies urban water to San Francisco and several other Bay Area cities. Average annual diversion from the Mokelumne and Tuolumne rivers that are directly exported from the basin include 245,000 acre feet through the Mokelumne Aqueduct and 267,000 acre feet through the Hetch-Hetchy Aqueduct. Major dams on the tributary streams include Pardee and Camanche dams on the Mokelumne River, New Melones, Donnells, and Beardsley dams on the Stanislaus River, O'Shaunessy and New Don Pedro dams on the Tuolumne River, and Exchequer Dam on the Merced River.

In 2000, an average water year, agriculture accounted for 57 percent of the region's total developed water use, while urban water use was about 5 percent and environmental water use for dedicated purposes was 38 percent of the total. Regional average urban per capita water use was about 304 gpcd. Imported supplies, including Central Valley Project, State Water Project, and other federal deliveries, amounted to 1,874,000 acre feet. Environmental demands, including for refuges, instream requirements, and wild and scenic flows, totaled 4,637,100 acre feet. Figure 7-4 summarizes the dedicated and developed urban, agricultural and environmental water uses in the region for 1998, 2000 and 2001.

The water balance table for the San Joaquin hydrologic region (Table 7-1) summarizes the detailed regional water accounting contained in the water portfolio table (Table 7-2) at the end of this chapter. As shown in Table 7-1 changes in groundwater storage are balanced with the available surface water each year to meet the regions needs. In wet years like 1998 excess water supply is added into ground water storage, while in dry years like 2001 the amount of groundwater pumped to meet water needs results in a net loss of groundwater storage. Table 7-3 provides more specific information about the developed or dedicated component of water supplies for agricultural, urban and environmental purposes, as assembled from actual data for 1998, 2000 and 2001.

State of the Region

Challenges

Historically, the surface water originating from Sierra Nevada rivers has proven to be a dependable supply of high quality water, but it meets only half of the region's total water requirement. Imported surface water and groundwater make up the difference. Because the region relies on imported surface water from other regions, there is growing concern over the long-term availability of external supplies. Additionally, proposals to restore fisheries on the San Joaquin River through larger releases of water from Friant Dam have resulted in growing concerns over the long-term availability of local Sierra water .

One of the major challenges facing the region is how to restore ecosystems, especially along the San Joaquin River below Friant Dam. The river receives no significant inflow until its confluence with the Merced River. The river's salmon population upstream of the Merced River, which once was very large, has all but disappeared. Restoring some flow to the San Joaquin River should help restore the ecosystem and help improve the reliability and quality of water available downstream for Delta farmers. However, such reallocations could significantly affect the water supplies for members of the Friant Water Users Authority, as well as have economic effects on the thousands of farmers, communities, public agencies, related businesses, employees and consumers who depend on the water from Friant Dam.

In 1988, the Natural Resources Defense Council and 13 other environmental and fishing groups filed a suit in U.S. District Court, seeking an injunction and declaratory judgment to prevent the U.S. Bureau of Reclamation from renewing long-term CVP water supply contracts without preparing environmental documentation and to require releases for instream uses from Friant Dam. It is still being litigated.

Maintaining the integrity of the Delta levee system is another major challenge. The Delta islands are protected by more than 1,000 miles of levees, and are commonly 10 to 15 feet below sea level. Failure of these levees could occur as the result of earthquakes or floods, gradual deterioration, or improper maintenance. Composed largely of peat soils, many islands are vulnerable to seepage and subsidence. Subsidence of peat soils and settling of levee foundations increase the risk of levee failure.

Groundwater pumping, a major source of supply in the region, continues to increase in response to growing urban and agricultural demands. Over the long-term, groundwater extraction cannot continually meet the portion of water demands that are not met by surface water supplies without causing negative impacts on the groundwater basin. One impact is groundwater overdraft, a condition where the average long-term amount of water pumped out exceeds the amount of water pumped in. A serious consequence of long-term groundwater overdraft is land subsidence, or a drop in the natural land surface. Land subsidence results in a loss of aquifer storage space and may cause damage to public facilities such as canals, utilities, pipelines, and roads. Pumping depressions have caused poor quality water from the Delta to migrate toward Eastern San Joaquin County. Several municipal wells in west Stockton have been abandoned because of the decline in groundwater quality. To help counteract potentially serious overdraft conditions in some areas of the region, groundwater replenishment is being provided through planned recharge programs, the over-irrigation of crops with extra surface water in wet years, incidental deep percolation, and seepage from unlined canal systems.

The major water quality problems of San Joaquin River region are a result of depleted freshwater flows, municipal and industrial wastewater discharges, salt loads in agricultural drainage and runoff, and other pollutants associated with agricultural irrigation and production, including nutrients, selenium, boron, organophosphate pesticides, such as diazinon and chlorpyrifos, and toxicity of unknown origin. The Central Valley--which covers San Joaquin River, as well as the Sacramento River and Tulare Lake basins--has 40 water bodies impaired due to agriculture, including 800 miles of waterways, and 40,000 acres in the Delta. In its most recent triennial review of its basin plan, the Central Valley Regional Board identified as high priorities salinity and boron discharges to the San Joaquin River, low dissolved oxygen problems in the lower San Joaquin, organophosphorous pesticide control generally, and a policy for protecting Delta drinking water quality.

High salinity is a problem in the San Joaquin basin, because of the greatly altered flows of the river; most of the San Joaquin is diverted from its natural course at Friant Dam. Moreover, irrigation water from State and federal projects annually import more than a half million tons of salt to the west side of the San Joaquin River region. Water released from New Melones Reservoir on the Stanislaus River is used to help meet the salinity and dissolved oxygen requirements at Vernalis on the San Joaquin. Agricultural drainage and discharges from managed wetlands are already regulated in the 370,000-acre Grasslands watershed, which contributes high levels of salts, selenium, boron, and nutrients to Mud and Salt Sloughs, which in turn are the primary contributors of selenium to the San Joaquin River. Dairies, stockyards, and poultry ranches are also a concern in the region for their loadings of pathogens, nutrients, salts, and emerging contaminants, such as antibiotics, to water bodies. Some dairies and other agricultural operations are already subject to regulatory review. Water releases from managed wetlands, part of State and federal wildlife refuge system, also discharge salts and nutrients. Erosion of west side streams is the primary source of organochlorine pesticides in the San Joaquin River.

Migrating and spawning salmonids face high temperatures in the Stanislaus, Tuolumne, and Merced rivers downstream from dams. Contaminated fish are a concern in these three rivers and the main stem of the San Joaquin River. One study found the 43-mile reach of the San Joaquin between its confluences with the Merced and the Stanislaus, to be toxic to fish about half the time. Low dissolved oxygen, or DO, in the Stockton Deepwater Ship Channel is attributable to high summer temperatures, low flows, nutrients, and channel configuration; this low DO area is potentially a barrier to fall run Chinook salmon migrating to the Merced, Tuolumne, and Stanislaus rivers to spawn.

Groundwater quality throughout the region is generally suitable for most urban and agricultural uses. There are, though, some 1,000 square miles of groundwater contaminated with salinity, mostly along the western edge of the valley floor, where the high-saline marine sediments of the Coast Range exist. The salinity of groundwater in the region increases when the evapotranspiration of crops and wetlands leaves behind the majority of the salt contained in the imported water. In addition, high water-table conditions underlying marginal lands along the west side of the San Joaquin River region contribute to subsurface drainage problems. In order to maintain a salt balance in the root zone, much of this salt is leached into the groundwater. For aesthetic purposes, such as taste, DHS regulations recommend that drinking water contain less than 500 mg/L of salinity as measured by total dissolved solids, or TDS; for agricultural uses, water with a salinity of less than 450 mg/L TDS is generally acceptable. While the DHS recommendation is adopted by reference into the basin plan to protect domestic use of groundwater, the basin plan contains no numerical salinity objectives for protection of agricultural beneficial uses.

Nitrates, from the disposal of human and animal waste products or the inefficient application of fertilizer or irrigation water, have contaminated 200 square miles of groundwater, presenting a threat to domestic water supplies. Pesticides have contaminated 500 square miles of groundwater, primarily in agricultural areas on the east side of the San Joaquin Valley, where soil permeability is higher and depth to groundwater shallower. The entire Central Valley is home to about 500,000 single-family residential septic systems. The most notable agricultural contaminant detected in groundwater samples from the region is dibromochloropropane, DBCP, a now-banned nematocide, found mostly along the State Route 99 corridor. There are 200 square miles of groundwater contaminated by naturally occurring selenium.

As of Jan.1, 2003, SB 390 ended previous conditional waivers of waste discharge requirements, or WDRs, for 23 types of waste discharges, including irrigated agriculture and logging. Previously, a petition from three environmental groups requested the rescinding of these waivers, because of concerns about pesticides in discharges. Unlike the federal Clean Water Act—which specifically exempts agricultural discharges from regulation—the State's Porter-Cologne Water Quality Control Act allows a waiver from regulation only if it is not against the public interest. The Central Valley RWQCB granted such a waiver to irrigated lands in 1982, exempting their discharges from WDRs. That waiver did have conditions, but because of a lack of staff resources, the RWQCB did not review compliance with them. SB 390 allows for the continuation of waivers, but only if specifically re-newed by the regional board, subject to a five-year review.

Relative to other regions, discharges from irrigated lands – which includes managed wetlands and nurseries--have their greatest impact in the Central Valley, which covers 40 percent of California's land area, and contains 7 million irrigated acres and at least 25,000 individual agricultural dischargers. As an interim measure, the Central Valley RWQCB adopted in July 2003 a pair of conditional waivers for such discharges to surface water, one for "coalition groups" and the other for individuals, covering surface runoff or tailwater, excess water diverted but not used, subsurface drainage to lower the water table for growing, and stormwater runoff. Commodity-specific and low-threat waivers and general permits may also be possible. Waiver conditions this time include water quality monitoring and implementation of BMPs or management measures to control pollution. This new waiver program, which focuses on capacity building and data collection, including monitoring for toxicity and drinking water constituents of concern expires on Dec. 31, 2005. Subsequently, a 10-year implementation program is envisioned to fully protect the state's waters for their beneficial uses from discharges from irrigated lands, in order to meet water quality objectives.

While agricultural land use affects water quality, rapid urbanization of the Central Valley, converting undeveloped or agricultural lands to residential and commercial use, may present different or new water quality problems in the future. The Central Valley Regional Board has recently begun requiring many municipal dischargers to implement costly tertiary treatment of wastewater.

Accomplishments

The Reclamation Board of California and the U.S. Army Corps of Engineers in coordination with a broad array of stakeholders, have developed a Comprehensive Plan for the flood management system of the Sacramento and San Joaquin River regions. Rather than a physical plan, the Comprehensive Plan constitutes an approach to developing projects in the future to reduce damage from flooding and restore the ecosystem.

The Millerton Area Watershed Coalition will conduct a comprehensive assessment of the San Joaquin River watershed and assess what activities need to be changed to better protect and care for the watershed. The information learned will be developed into outreach to promote the protection and enhancement of the watershed including the economic and environmental well-being of the communities within it, as well as of the downstream users. This is a CALFED Watershed Program through the USBR.

The San Joaquin River Group Authority was formed in the 1990s in response to the development of the Sacramento – San Joaquin Bay Delta Water Quality Control Plan by the State Water Resources Control Board. The WQCP was adopted in 1995 and included significant water quality and flow standards for the lower San Joaquin River. The goals of the SJRGA are to investigate fishery and water quality issues on the San Joaquin River, and develop solutions that will protect the salmon fishery and improve water quality. To respond to water quality issues, the Regional Water Quality Control Board is studying agricultural discharge quality controls, and may consider the use of agriculture waivers at a watershed level. Additional water quality monitoring will be necessary to address the various water quality problems on the Lower San Joaquin River. Landowners will have the choice of participating in water quality monitoring and improvement programs on a watershed level or on an individual basis. The watershed approach can be used to identify and address “hot spots” by working directly with individual landowners or encouraging individuals to work together to find solutions.

The SJRGA also led the development of the Vernalis Adaptive Management Plan as a 10-year test program designed to study methods to improve salmon smolt survival in the lower San Joaquin River. Starting in the year 2000, VAMP has coordinated the release of water from upstream reservoirs each spring to generate a calculated pulse flow down the lower river to help salmon smolts migrate to San Francisco Bay and the ocean. The timing and duration of this pulse flow is coordinated with reduced SWP and CVP Delta export pumping in order to improve Delta flow patterns that will guide the salmon smolts to the ocean. VAMP’s technical group coordinates extensively with several local and government agencies to oversee the successful test flow each year, which include real-time facility operations and monitoring, tracking of water flows and fish migration, and outreach and education. It is still too early in the 10-year test to determine how successful this program will be.

The Upper San Joaquin River Basin Storage Investigation evolved out of the CALFED Record of Decision of 2000. It states that “250 to 700 TAF of additional storage in the upper San Joaquin watershed…would be designed to contribute to restoration of and improve water quality for the San Joaquin River and facilitate conjunctive water management and water exchanges that improve the quality of water deliveries to urban communities. Additional storage could come from enlargement of Millerton Lake at Friant Dam or a functionally equivalent storage program in the region.” Surface storage options in the San Joaquin River region that may be considered after completion of the CALFED Phase I process include of the investigation of (1) raising Friant Dam, (2) Fine Gold Creek Dam, and (3) Temperance Flat

Dam, which includes three sites. Additionally, Yokohl Valley Reservoir near Visalia in the Tulare Lake region is also under consideration.

The Farmington Groundwater Recharge and Seasonal Habitat Program is a regional effort to recharge the underground aquifer in the Eastern San Joaquin County Basin. The Basin aquifer is threatened by the eastward movement of saltwater from the Delta, which could eventually contaminate municipal wells in Stockton and limit the ability of farmers to grow anything besides salt-tolerant, low-value crops. By periodically spreading an average of 35,000 acre feet of surplus water per year using the flooded-field method, the program is intended to reduce groundwater overdraft and establish a barrier to prevent saline water intrusion. The $33.5 million program is a partnership between Stockton East Water District and the U.S. Army Corps of Engineers. The program will initially seek to secure flooding rights on about 25 agricultural parcels totaling 1,200 acres. The initial 35,000 acre feet per year objective was based on the Farming Groundwater Recharge and Seasonal Habitat Study, which was completed in 2001. Stockton East Water District was the lead local sponsor of the feasibility study with the U.S. Army Corps of Engineers. Other study participants included Central San Joaquin Water Conservation District, North San Joaquin Water Conservation District, City of Stockton, San Joaquin County, and California Water Service Company.

Through the South San Joaquin County Surface Water Supply Project, the cities of Tracy, Manteca, Lathrup and Escalon have joined with the South San Joaquin Irrigation District to plan for a water treatment plant on the Stanislaus River. The project will use water that the SSJID has conserved from its efficient irrigation practices. Water will be taken from Woodward Reservoir, treated to drinking standards and conveyed to the cities. A 40-mile long transmission pipeline would also be built from the treatment plant to deliver water to each of the participant cities. The $150 million project is expected to begin deliveries around May 2005. The project is scheduled to deliver 30,000 acre feet per year to the cities through 2010 and up to 44,000 acre feet per year thereafter. The intent of the project is to reduce the reliance on groundwater and to satisfy future urban demand increases.

Relationship with Other Regions

The San Joaquin River region is dependent on receiving surface water from other regions of the state to meet a portion of the developed agricultural and urban water uses. For many years, the region has received imported CVP water from the Sacramento-San Joaquin Delta via the Delta Mendota Canal and from the CVP’s Friant Dam, which also diverts Sierra water to the Tulare Lake region. The region also receives some SWP water from the California Aqueduct.

Some surface supplies that originate in the San Joaquin region are also diverted across the valley to the San Francisco Bay Region via the Mokelumne Aqueduct by the East Bay Municipal Utility District, and the Hetch Hetchy Aqueduct by San Francisco. The average annual diversions by these two projects from the Mokelumne and Tuolumne rivers are about 245,000 acre feet per year through the Mokelumne Aqueduct and 267,000 acre feet per year through the Hetch-Hetchy Aqueduct.

In 1998, Contra Costa Water District completed Los Vaqueros Reservoir, which can hold 100,000 acre feet. It is an off-stream reservoir in the northwest corner of the San Joaquin hydrologic region. This reservoir holds CCWD water that has been diverted from the Delta in the late winter and spring. Water is typically withdrawn from Los Vaqueros Reservoir to meet summer demands in the CCWD service area.

However, since the CCWD service area is in the San Francisco Bay hydrologic region, this water is considered to be an export from the San Joaquin region. Los Vaqueros has only been operated for a few years. Normal patterns of diversion and water use have not yet been established.

Looking to the Future

The region's water agencies have many projects and programs to address water supply problems. These include investigations for new local surface storage and investigations for storage development in conjunction with CALFED. Local agencies are further implementing conjunctive use projects and increasing their efforts on water use efficiency and water recycling programs. As the urban cities in the valley continue to grow and expand, the current trend of agricultural land converting to subdivisions is likely to continue. As an outcome of urban expansion, urban water usage is expected to increase in the future, while agricultural water use is projected to decline slightly. The effectiveness of urban and agricultural water conservation and use efficiency measures will influence these water use trends.

Regional Planning

The San Joaquin Valley Water Coalition is a forum where all the interests in the valley can come together to discuss common issues related to water supply, quality, and distribution to ensure a water supply for the valley that is sustainable and meets the needs and concerns of all water users. The Westside Integrated Water Resources Plan, initiated in 2000, is evaluating supply increases and demand reductions to correct the water supply deficits caused by the Central Valley Project Improvement Act. The West Stanislaus Hydrologic Unit Area Project is a U.S. Department of Agriculture and local grower effort to enhance water quality by reducing soil erosion into the San Joaquin River.

Many other programs are focusing on ecosystem restoration on the Merced, Stanislaus, Tuolumne, and San Joaquin rivers. The Grassland Bypass Project on the west side of the valley will consolidate the conveyance of subsurface drainflows on a regional basis and use a portion of the federal San Luis Drain to convey drainflows around the Grassland habitat areas into Mud Slough before being discharged into the San Joaquin River above its confluence with the Merced River. The San Joaquin River Parkway and Conservation Trust's goals are to preserve and restore San Joaquin River lands having ecological, scenic or historic significance, educate the public on the need for stewardship, research issues affecting the river, and promote educational, recreational and agricultural uses consistent with the protection of the river's resources.

Work is continuing on several programs at the watershed level in the region. For example, the San Joaquin River Management Program is seeking solutions to the common problems facing the region that affect the environment, water quality, agriculture, and flood control in the San Joaquin River watershed, without the limitations imposed by political boundaries. Also, several public and private partnerships on the east side of the valley are attempting to develop a Comprehensive Plan for the Management, Protection and Restoration of Watersheds of the San Joaquin, Merced, Chowchilla, and Fresno rivers and to attain designation as a Resource Conservation and Development Area, so watershed projects can be coordinated in Mariposa County and eastern Madera County.

Water Portfolios for Water Years 1998, 2000, and 2001

Water Year 1998

California experienced El Nino from July 1997 to June 1998 in water-year 1998. The previous El Nino was in 1991-1992. Precipitation records were broken all over the state. Precipitation in Fresno exceeded 180 percent of average, Stockton had almost 200 percent of average, and Los Banos had 248 percent of average. Watershed runoff was well above average, as streamflow in the San Joaquin, Merced, Stanislaus and Tuolumne rivers was about 165 percent of average. More detailed information about how these available water supplies are distributed and used on a region-wide basis is presented in water portfolio Table 7-2, and the three companion Water Portfolio flow diagrams (Figures 7-5, 7-6 and 7-7) .

Total irrigated acreage was about 2,053,700 acres. Alfalfa acreage accounted for 11.5 percent of all irrigated crop acreage in the San Joaquin region; almond and pistachio acreage accounted for 13.8 percent; and vineyard acreage, 10.9 percent. Compared to 1995 acreage, irrigated pasture acreage was down to 15,400 acres; however, acreage was up for corn at 36,800 acres, almonds and pistachios at 8,600 acres, and vineyards at 29,600 acres. Thus, growers continued the trend of converting field cropland to almond and pistachio orchards and vineyards in an effort to find a commodity that would provide better long-term profits.

The El Nino phenomenon had such an impact on the San Joaquin region's volume of precipitation that growers in most cases had little need to irrigate during the first four to five months of 1998. The total 1998 agricultural on-farm applied water was 4.8 million acre feet, and total agricultural water use was 5.5 million acre feet or 47 percent of all uses. The regional average agricultural on-farm unit applied water was 2.4 acre feet per acre. The total agricultural evapotranspiration of applied water, or ETAW, in 1998 amounted to 3.4 million acre feet. The regional average unit ETAW was 1.7 acre feet per acre.

Total urban applied water use, including residential, commercial, industrial, and landscape, in the region totaled over 562,500 acre feet. The average per capita water use was about 301 gallons per day, and the urban ETAW was 189,000 acre feet. Urban water use accounted for about 5 percent of the total water use in the region. Population for the region was 1,669,890, 4.9 percent more than 1995.

Total environmental water use for instream, wild and scenic, and refuges, for the region was about 5.6 million acre feet. This accounts for 48 percent of total uses. Environmental demand includes water that is reserved for instream and wild and scenic river flow but can be used later as a supply by downstream users. Refuge supplies, which are supplies applied directly onto wildlife refuges, accounts for 414,500 acre feet, or 4 percent of total uses.

Total supplies, including local and imported CVP and SWP surface water, groundwater, and reuse, amounted to 11.6 million acre feet.

Water Year 2000

The weather of water year 1999-2000 in the San Joaquin River region produced average precipitation and streamflow. Rainfall amounts were slightly above average for most of the measuring stations in the region; precipitation as a percentage of average in Madera and Modesto was 120 percent, 99 percent for Stockton, and 88 percent for Los Banos. Ample moisture was received in the local watersheds, and runoff resulted in good water supplies. Watershed runoff was about average, with unimpaired runoff from the

Tuolumne, Merced and San Joaquin rivers at about 103 percent of average. However, the Stanislaus, Mokelumne, and Cosumnes rivers were 99, 89, and 70 percent, respectively. Heavy rainfall occurred in January and February, delaying many field activities such as pruning, planting, spraying, and field preparation.

Total irrigated acreage decreased only slightly from 1998 to 2000, reaching 2,050,400 acres. The 2000 almond and pistachio acreage of 292,500 acres was 9,300 acres higher than the acreage in 1998. The acreage of sugar beets dropped 26 percent to 18,500 acres. The acreages of most the remaining crops changed little from 1998.

In general, 2000 weather, water supplies, and evaporative demand were close to average in the San Joaquin region. The total agricultural on-farm applied water in 2000 was 6.2 million acre feet, and total agricultural water use was 7 million acre feet or 57 percent of all uses, about 29 percent more than 1998. The regional average on-farm unit applied water use was 3 acre feet per acre. The total agricultural ETAW was about 4.4 million acre feet, 29 percent higher than 1998. The regional average unit ETAW was 2.1 acre feet per acre.

Total urban water use for the region was 594,000 acre feet, which was about 6 percent higher than the total urban water use for 1998. Average per capita water use was around 304 gallons per day, and total urban ETAW for the year was about 207,900 acre feet, 10 percent higher than 1998. Urban applied water accounted for about 5 percent of the total water use in the region. Population for the region was 1,751,010 or 4.9 percent more than 1998.

Total environmental water use for instream, wild and scenic, and refuges for the region was about 4.6 million acre feet, 17 percent less than in 1998. This accounts for 38 percent of total uses. Refuge supplies accounted for 444,800 acre feet or 4 percent of total uses.

Total supplies, including local and imported CVP and SWP surface water, groundwater, and reuse, amounted to 12.3 million acre feet, a 6 percent increase from 1998.

Water Year 2001

The 2000-2001 water year started out cooler than normal with cumulative rainfall below average through most of January. Rainfall amounts were slightly less than average for the water year with annual totals of 88 and 83 percent of average in Madera and Stockton, respectively. As the accumulated precipitation lagged in January, large scale weather patterns changed significantly as February approached and a series of Pacific storms moved into the state, helping to bring precipitation totals closer to average. This cool, wet period delayed many cultural activities such as pruning, planting, spraying, and ground preparation. A thunderstorm on April 7 brought wind, hail, and heavy rain that damaged grapevines, cotton, grains, and vegetables in Madera and Merced counties; cotton fields damaged by the storm were replanted. The weather became warmer by late April and through the remainder of the growing season offered good growing conditions.

Irrigated crop acreage totaled 2,042,700 acres, a 7,700 reduction from water year 1998. Irrigated pasture acreage decreased to 158,800 acres, 28,900 acres or 15.4 percent decline from 1998; sugar beet acreage decreased to 7,600 acres, a 70 percent decline from 1998. However, miscellaneous truck crop acreage increased 10,800 acres or 16.7 percent over 1998, and vineyard acreage increased 18,800 acres or 8.4 percent, while almond and pistachios have increased by 13,000 acres since 1998.

The total agricultural on-farm applied water for 2001 was 6.5 million acre feet, and total agricultural water use was 7.2 million acre feet or 67 percent of all water uses, 31 percent more than 1998 and 2 percent more than 2000. The regional average on-farm unit applied water was 3.2 acre feet per acre. The total agricultural ETAW was estimated to be 4.6 million acre feet. This was about 36 percent higher than 1998 and 5 percent higher than 2000. The regional average unit ETAW was 2.3 acre feet per acre.

Total urban water use for the region was 622,800 acre feet, which was 11 percent higher than 1998 and 5 percent higher than 2000. Average per capita water use was about 307 gallons per day, and total urban ETAW was about 216,300 acre feet, a 14 percent increase from 1998 and 4 percent increase from 2000. Urban water use accounted for about 6 percent of the total water use in the region. Population for the region was 1,812,710, 8.6 percent more than 1998.

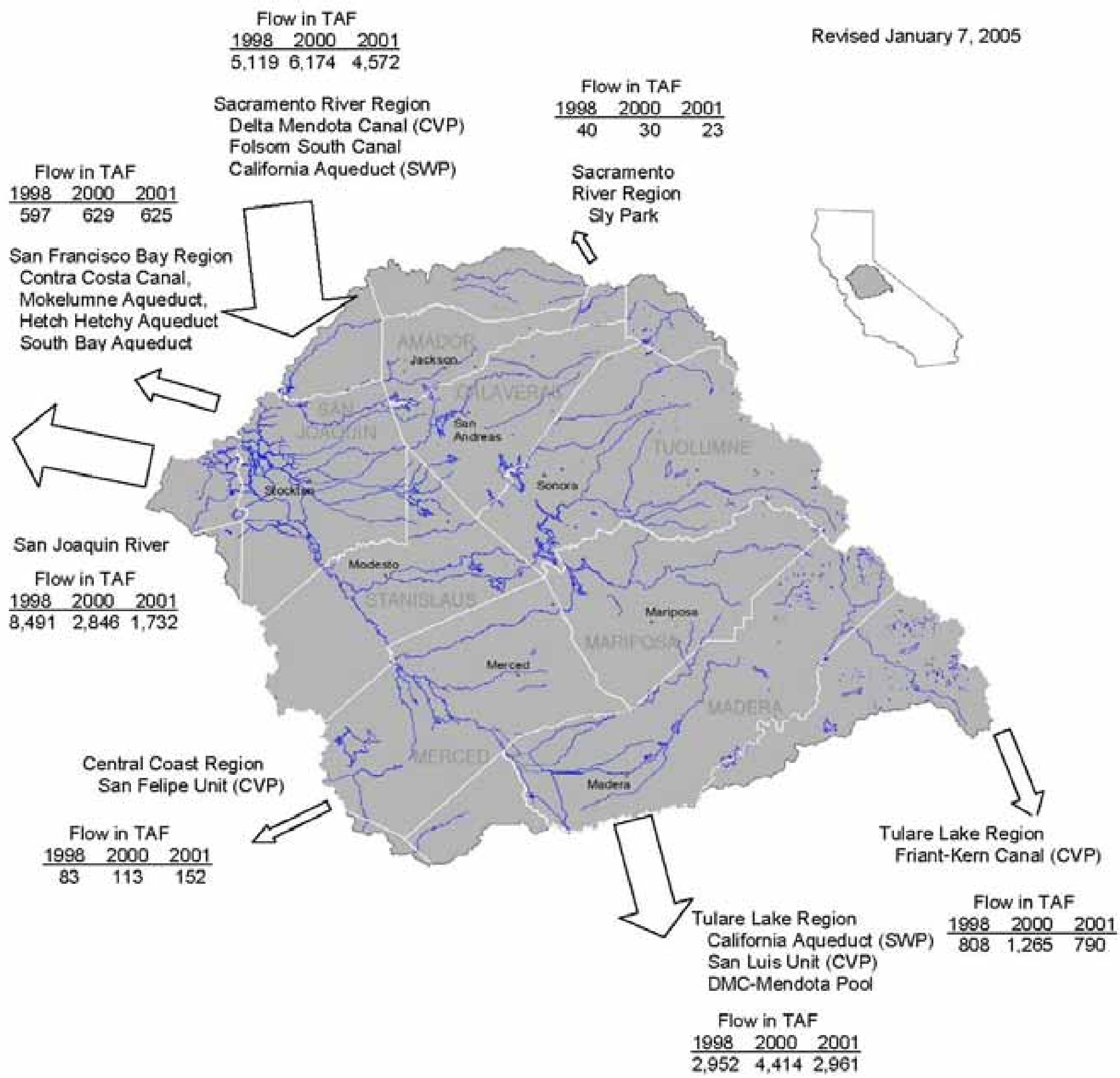
Total environmental water use for instream, wild and scenic, and refuges for the region was about 2.9 million acre feet, 48 percent less than in 1998 and 37 percent less than in 2000. This accounts for 27 percent of total uses. Refuge supplies accounted for 414,700 acre feet or 4 percent of total uses.

Total supplies, including local and imported from CVP and SWP surface water, groundwater, and reuse, amounted to 10.7 million acre feet, 8 percent less than 1998 and 13 percent less than 2000.

Sources of Information

- Water Quality Control Plan, Regional Water Quality Control Board
- Watershed Management Initiative Chapter, Regional Water Quality Control Board
- 2002 California 305(b) Report on Water Quality, State Water Resources Control Board
- Bulletin 118 (Draft), California's Groundwater, Update 2003, Department of Water Resources
- Strategic Plan, State Water Resources Control Board, Regional Water Quality Control Boards, November 15, 2001
- U.S. Bureau of Reclamation
- San Joaquin River Management Program Advisory Council
- The Modesto Bee
- Contra Costa Water District
- Programmatic Record of Decision, California Bay-Delta Program, August 28, 2000.
- Farmington Groundwater Recharge Program website, http://www.farmingtonprogram.org

Figure 7-1
San Joaquin River Hydrologic Region



Some Statistics

- Area - 15,214 square miles (9.6% of State)
- Average annual precipitation – 26.3 inches
- Year 2000 population - 1,751,010
- 2030 projected population – 3,385,885
- Total reservoir storage capacity - 11,477 TAF
- 2000 irrigated agriculture - 2,050,400 acres

Figure 7-2
San Joaquin Hydrologic region Population

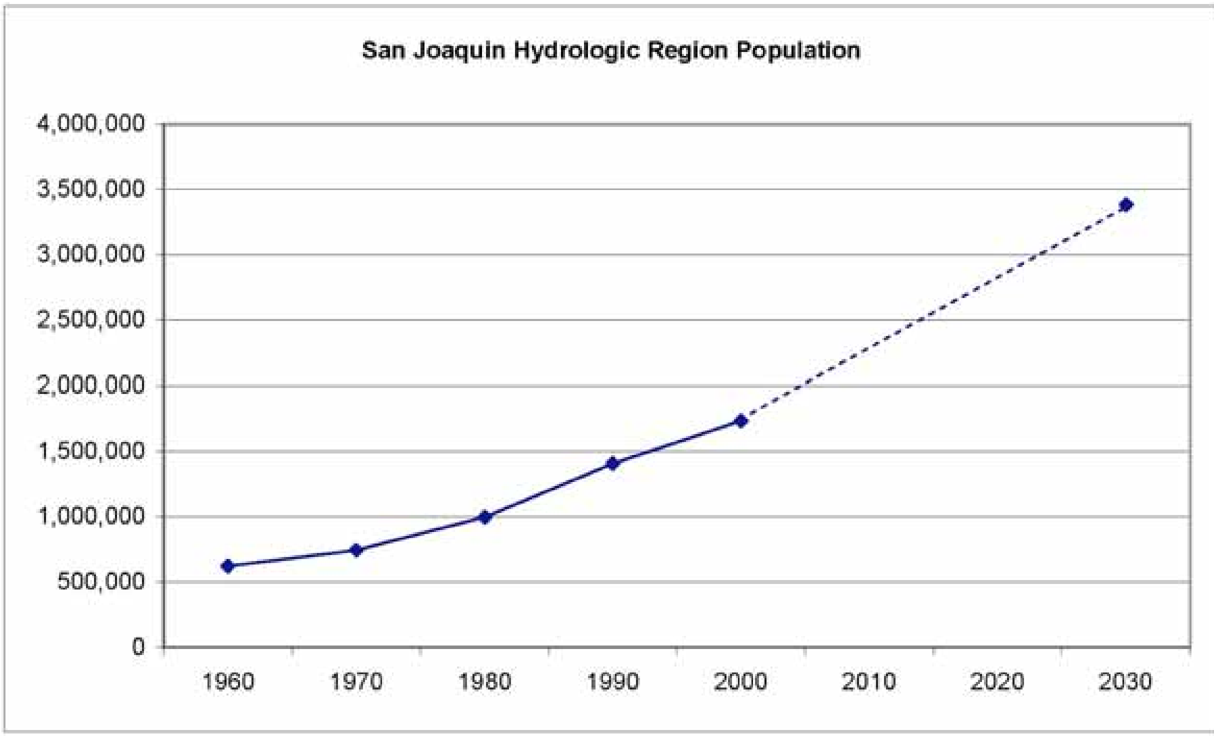


Figure 7-3
San Joaquin River Region Dedicated Water Supplies For Water Years 1998, 2000, 2001

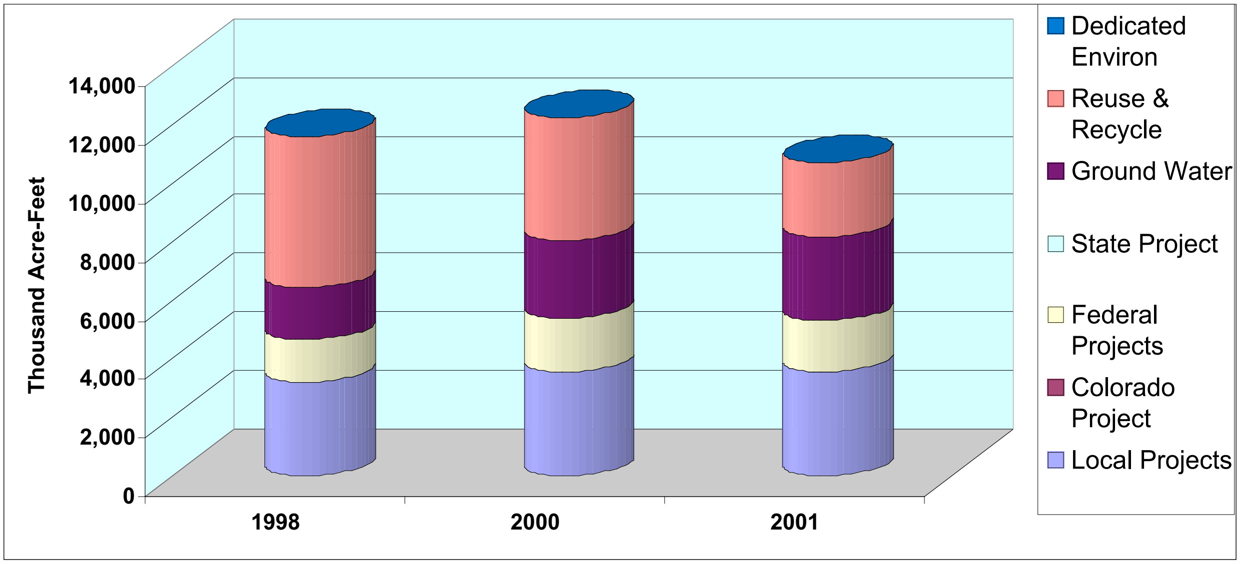


Figure 7-4
San Joaquin River Region Applied Water Uses For Water Years 1998, 2000, 2001

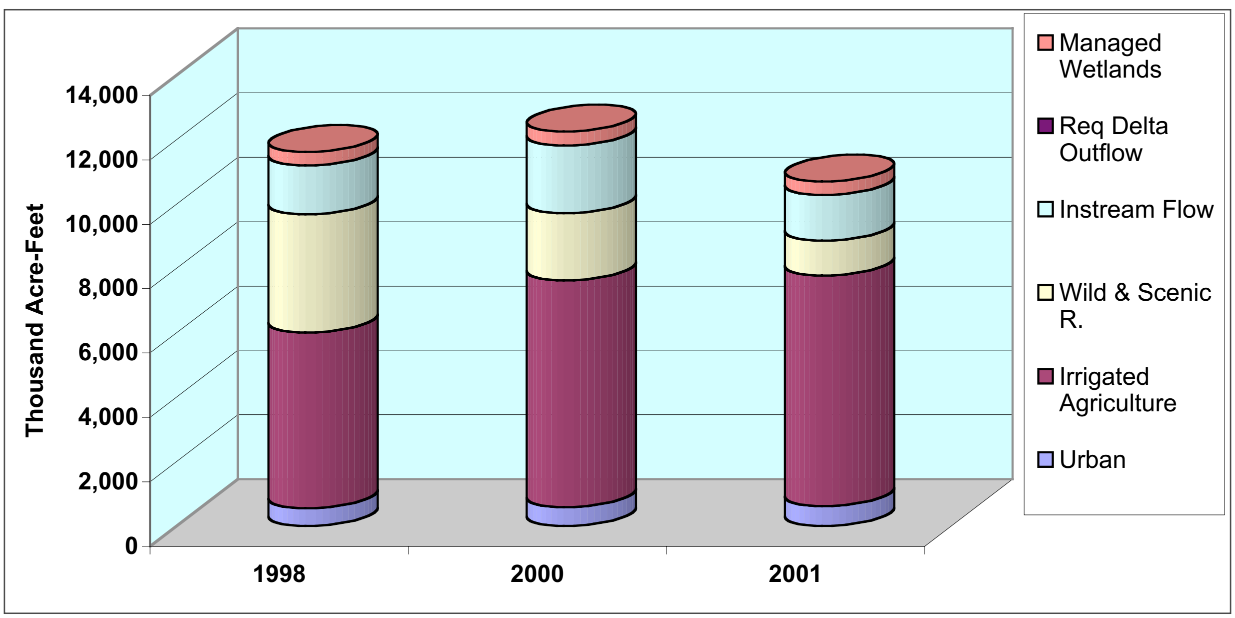


Table 7-1
San Joaquin River Hydrologic Region Water Balance Summary – TAF

Water Entering the Region – Water Leaving the Region = Storage Changes in Region

	Water Year (Percent of Normal Precipitation)		
	1998 (174%)	2000 (113%)	2001 (79%)
Water Entering the Region			
Precipitation	35,535	23,209	16,120
Inflow from Oregon/Mexico	0	0	0
Inflow from Colorado River	0	0	0
Imports from Other Regions	5,192	5,288	3,890
Total	**40,727**	**28,497**	**20,010**
Water Leaving the Region			
Consumptive Use of Applied Water * (Ag, M&I, Wetlands)	3,703	4,764	4,981
Outflow to Oregon/Nevada/Mexico	0	0	0
Exports to Other Regions	4,013	5,848	4,073
Statutory Required Outflow to Salt Sink	0	0	0
Additional Outflow to Salt Sink	183	196	218
Evaporation, Evapotranspiration of Native Vegetation, Groundwater Subsurface Outflows, Natural and Incidental Runoff, Ag Effective Precipitation & Other Outflows	31,023	17,719	13,435
Total	**38,922**	**28,527**	**22,707**
Storage Changes in the Region [+] Water added to storage [–] Water removed from storage			
Change in Surface Reservoir Storage	2,248	67	-1,435
Change in Groundwater Storage **	-443	-97	-1,262
Total	**1,805**	**-30**	**-2,697**

Applied Water * (compare with Consumptive Use) * Definition - Consumptive use is the amount of applied water used and no longer available as a source of supply. Applied water is greater than consumptive use because it includes consumptive use, reuse, and outflows.	6,029	7,594	7,722

**Footnote for change in Groundwater Storage

Change in Groundwater Storage is based upon best available information. Basins in the north part of the State (North Coast, San Francisco, Sacramento River and North Lahontan Regions and parts of Central Coast and San Joaquin River Regions) have been modeled – Spring 1997 to Spring 1998 for the 1998 water year and Spring 1999 to Spring 2000 for the 2000 water year. All other regions and Year 2001 were calculated using the following equation:

GW change in storage =
intentional recharge + deep percolation of applied water + conveyance deep percolation – withdrawals

This equation does not include the unknown factors such as natural recharge and subsurface inflow and outflow

Table 7-2
Water Portfolios for Water Years 1998, 2000 and 2001

Category	Description	San Joaquin River 1998 (TAF)				San Joaquin River 2000 (TAF)				San Joaquin River 2001 (TAF)				Data Detail
Inputs:		Water Portfolio	Applied Water	Net Water	Depletion	Water Portfolio	Applied Water	Net Water	Depletion	Water Portfolio	Applied Water	Net Water	Depletion	
1	Colorado River Deliveries		-				-				-			PSA/DAU
2	Total Desalination		-				-				-			PSA/DAU
3	Water from Refineries		-				-				-			PSA/DAU
4a	Inflow From Oregon		-				-				-			PSA/DAU
b	Inflow From Mexico		-				-				-			PSA/DAU
5	Precipitation	35,534.7				23,208.5				16,120.2				REGION
6a	Runoff - Natural	N/A				N/A				N/A				REGION
b	Runoff - Incidental	N/A				N/A				N/A				REGION
7	Total Groundwater Natural Recharge	N/A				N/A				N/A				REGION
8	Groundwater Subsurface Inflow	-				-				-				REGION
9	Local Deliveries		3,228.0				3,540.7				3,548.3			PSA/DAU
10	Local Imports		-				-				-			PSA/DAU
11a	Central Valley Project :: Base Deliveries		12.8				12.8				12.8			PSA/DAU
b	Central Valley Project :: Project Deliveries		1,352.3				1,790.7				1,649.1			PSA/DAU
12	Other Federal Deliveries		64.3				65.8				97.6			PSA/DAU
13	State Water Project Deliveries		4.3				4.7				3.5			PSA/DAU
14a	Water Transfers - Regional		-				-				-			PSA/DAU
b	Water Transfers - Imported		-				-				-			PSA/DAU
15a	Releases for Delta Outflow - CVP		-				-				-			REGION
b	Releases for Delta Outflow - SWP		-				-				-			REGION
c	Instream Flow Applied Water		1,528.9				2,098.5				1,424.4			REGION
16	Environmental Water Account Releases		-				-				-			PSA/DAU
17a	Conveyance Return Flows to Developed Supply - Urban		-				-				-			PSA/DAU
b	Conveyance Return Flows to Developed Supply - Ag		-				-				-			PSA/DAU
c	Conveyance Return Flows to Developed Supply - Managed Wetland		-				-				-			PSA/DAU
18a	Conveyance Seepage - Urban		-				-				-			PSA/DAU
b	Conveyance Seepage - Ag		-				-				0.2			PSA/DAU
c	Conveyance Seepage - Managed Wetlands		-				-				-			PSA/DAU
19a	Recycled Water - Agriculture		1.2				1.2				1.2			PSA/DAU
b	Recycled Water - Urban		0.7				0.7				0.7			PSA/DAU
c	Recycled Water - Groundwater		-				-				-			PSA/DAU
20a	Return Flow to Developed Supply - Ag		1,179.4				949.1				968.4			PSA/DAU
b	Return Flow to Developed Supply - Wetlands		132.6				126.7				134.2			PSA/DAU
c	Return Flow to Developed Supply - Urban		-				-				-			PSA/DAU
21a	Deep Percolation of Applied Water - Ag		157.7				844.2				910.1			PSA/DAU
b	Deep Percolation of Applied Water - Wetlands		174.3				166.5				142.3			PSA/DAU
c	Deep Percolation of Applied Water - Urban		204.2				219.1				225.7			PSA/DAU
22a	Reuse of Return Flows within Region - Ag		-				-				-			PSA/DAU
b	Reuse of Return Flows within Region - Wetlands, Instream, W&S		5,190.0				4,192.3				2,515.4			PSA/DAU
24a	Return Flow for Delta Outflow - Ag		-				-				-			PSA/DAU
b	Return Flow for Delta Outflow - Wetlands, Instream, W&S		1.6				1.6				1.5			PSA/DAU
c	Return Flow for Delta Outflow - Urban Wastewater		-				-				-			PSA/DAU
25	Direct Diversions	N/A				N/A				N/A				PSA/DAU
26	Surface Water in Storage - Beg of Yr	6,943.0				7,378.6				7,446.0				PSA/DAU
27	Groundwater Extractions - Banked	-				-				-				PSA/DAU
28	Groundwater Extractions - Adjudicated	-				-				-				PSA/DAU
29	Groundwater Extractions - Unadjudicated	1,771.5				2,656.3				2,878.3				REGION
Withdrawals:	In Thousand Acre-feet													
23	Groundwater Subsurface Outflow	N/A				N/A				N/A				REGION
30	Surface Water Storage - End of Yr	9,190.7				7,446.0				6,010.8				PSA/DAU
31	Groundwater Recharge-Contract Banking		-				-				-			PSA/DAU
32	Groundwater Recharge-Adjudicated Basins		-				-				-			PSA/DAU
33	Groundwater Recharge-Unadjudicated Basins		-				-				-			REGION
34a	Evaporation and Evapotranspiration from Native Vegetation				N/A				N/A				N/A	REGION
b	Evaporation and Evapotranspiration from Unirrigated Ag				N/A				N/A				N/A	REGION
35a	Evaporation from Lakes				77.3				89.7				82.0	REGION
b	Evaporation from Reservoirs				419.9				477.1				449.3	REGION
36	Ag Effective Precipitation on Irrigated Lands		1,514.0				870.3				820.0			REGION
37	Agricultural Water Use		5,079.1	4,921.4	3,486.5		6,572.6	5,728.4	4,422.6		6,704.7	5,794.6	4,654.5	PSA/DAU
38	Managed Wetlands Water Use		414.5	240.2	105.9		444.8	278.3	149.7		414.7	272.4	136.6	PSA/DAU
39a	Urban Residential Use - Single Family - Interior		92.4				100.2				104.9			PSA/DAU
b	Urban Residential Use - Single Family - Exterior		170.7				184.3				195.5			PSA/DAU
c	Urban Residential Use - Multi-family - Interior		81.5				88.8				92.4			PSA/DAU
d	Urban Residential Use - Multi-family - Exterior		41.0				44.6				45.8			PSA/DAU
40	Urban Commercial Use		34.1				37.2				39.2			PSA/DAU
41	Urban Industrial Use		85.7				88.8				89.5			PSA/DAU
42	Urban Large Landscape		30.0				32.7				35.4			PSA/DAU
43	Urban Energy Production		-				-				-			PSA/DAU
44	Instream Flow		1,528.9	-	-		2,098.5	-	-		1,424.4	-	-	PSA/DAU
45	Required Delta Outflow		-	-	-		-	-	-		-	-	-	PSA/DAU
46	Wild and Scenic Rivers		3,661.1	-	-		2,093.6	-	-		1,091.0	-	-	PSA/DAU
47a	Evapotranspiration of Applied Water - Ag				3,408.1				4,406.0				4,627.8	PSA/DAU
b	Evapotranspiration of Applied Water - Managed Wetlands				105.9				149.7				136.6	PSA/DAU
c	Evapotranspiration of Applied Water - Urban				189.0				207.9				216.3	PSA/DAU
48	Evaporation and Evapotranspiration from Urban Wastewater				N/A				N/A				N/A	REGION
49	Return Flows Evaporation and Evapotranspiration - Ag				74.4				11.6				14.3	PSA/DAU
50	Urban Waste Water Produced	117.8				123.4				131.8				REGION
51a	Conveyance Evaporation and Evapotranspiration - Urban				13.6				11.9				13.2	PSA/DAU
b	Conveyance Evaporation and Evapotranspiration - Ag				207.7				248.8				245.5	PSA/DAU
c	Conveyance Evaporation and Evapotranspiration - Managed Wetlands				-				-				-	PSA/DAU
d	Conveyance Loss to Mexico				-				-				-	PSA/DAU
52a	Return Flows to Salt Sink - Ag				26.7				40.4				50.3	PSA/DAU
b	Return Flows to Salt Sink - Urban				155.8				155.5				167.7	PSA/DAU
c	Return Flows to Salt Sink - Wetlands				-				-				-	PSA/DAU
53	Remaining Natural Runoff - Flows to Salt Sink				0.2				-				-	REGION
54a	Outflow to Nevada													REGION
b	Outflow to Oregon													REGION
c	Outflow to Mexico													REGION
55	Regional Imports	5,191.8				5,287.6				3,890.3				REGION
56	Regional Exports	4,013.3				5,848.3				4,073.1				REGION
59	Groundwater Net Change in Storage	-442.9				-97.2				-1,262.4				REGION
60	Surface Water Net Change in Storage	2,247.7				67.4				-1,435.2				REGION
61	Surface Water Total Available Storage	11,372.3				11,477.1				11,477.1				REGION

Colored spaces are where data belongs. N/A - Data Not Available "-" - Data Not Applicable "0" - Null value

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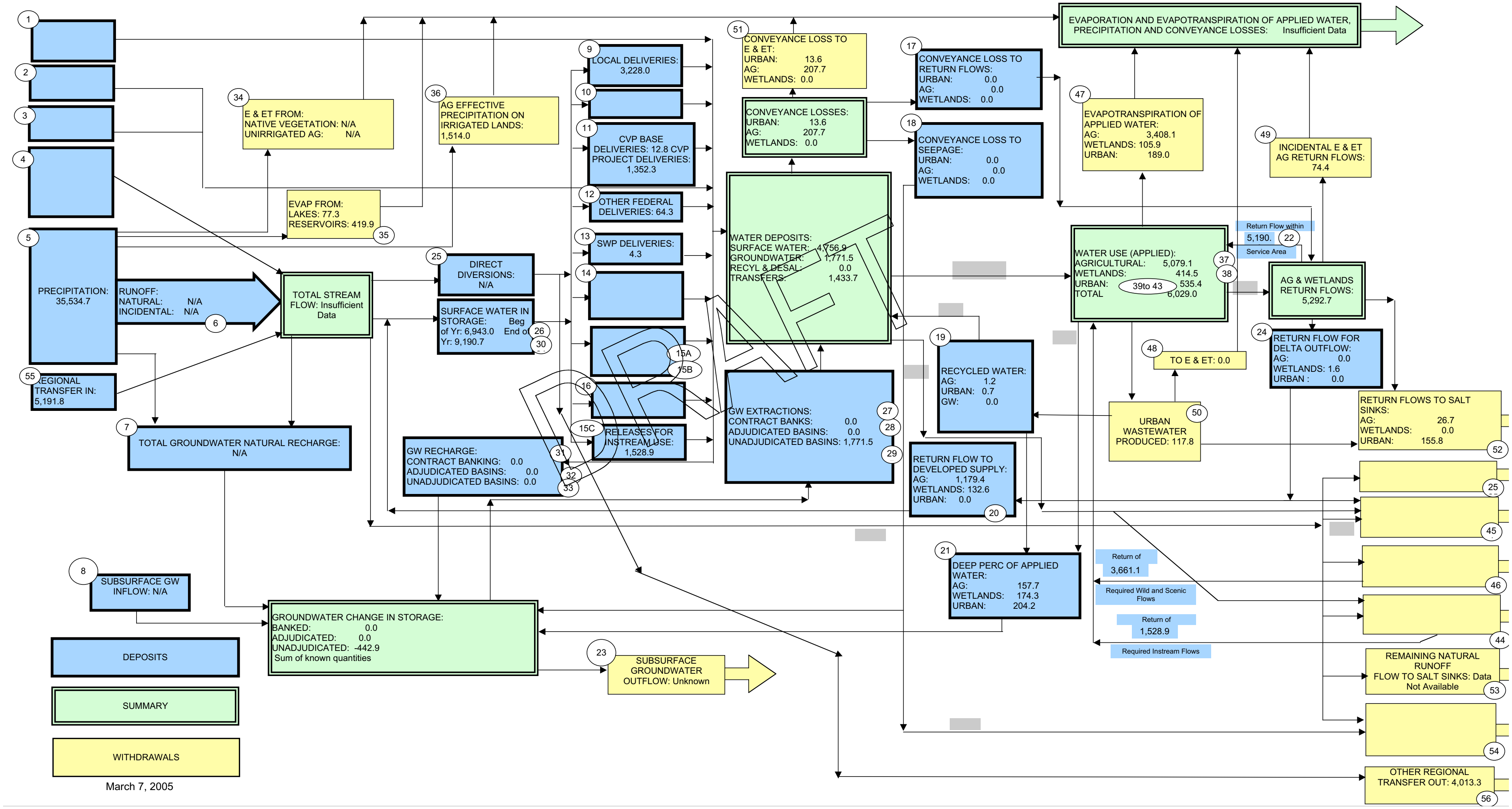
Table 7-3
San Joaquin River Hydrologic Region Water Use and Distribution of Dedicated Supplies - TAF

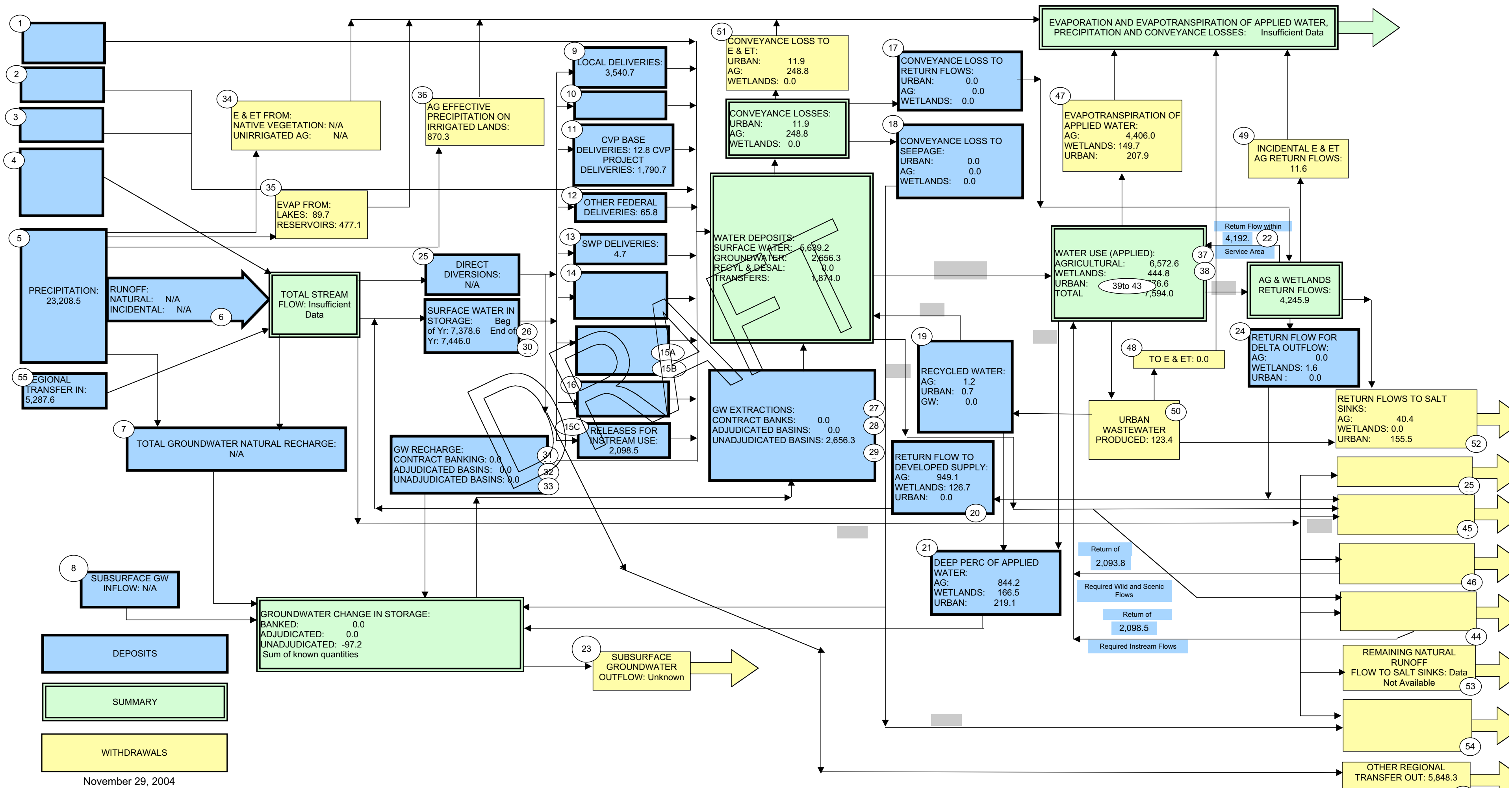
	1998			2000			2001		
	Applied Water Use	Net Water Use	Depletion	Applied Water Use	Net Water Use	Depletion	Applied Water Use	Net Water Use	Depletion
WATER USE									
Urban									
Large Landscape	30.0			32.7			35.4		
Commercial	34.1			37.2			39.2		
Industrial	85.7			88.8			89.5		
Energy Production	0.0			0.0			0.0		
Residential - Interior	173.9			189.0			197.3		
Residential - Exterior	211.7			228.9			241.3		
Evapotranspiration of Applied Water		189.0	189.0		207.9	207.9		216.3	216.3
Irrecoverable Losses		0.0	0.0		0.0	0.0		0.0	0.0
Outflow		142.3	142.3		150.0	150.0		160.8	160.8
Conveyance Losses - Applied Water	27.1			17.4			20.1		
Conveyance Losses - Evaporation		13.6	13.6		11.9	11.9		13.2	13.2
Conveyance Losses - Irrecoverable Losses		0.0	0.0		0.0	0.0		0.0	0.0
Conveyance Losses - Outflow		13.5	13.5		5.5	5.5		6.9	6.9
GW Recharge Applied Water	0.0			0.0			0.0		
GW Recharge Evap + Evapotranspiration		0.0	0.0		0.0	0.0		0.0	0.0
Total Urban Use	**562.5**	**358.4**	**358.4**	**594.0**	**375.3**	**375.3**	**622.8**	**397.2**	**397.2**
Agriculture									
On-Farm Applied Water	4,823.6			6,216.0			6,533.0		
Evapotranspiration of Applied Water		3,408.1	3,408.1		4,406.0	4,406.0		4,627.8	4,627.8
Irrecoverable Losses		74.4	74.4		11.6	11.6		14.3	14.3
Outflow		1,183.4	4.0		954.1	5.0		980.8	12.4
Conveyance Losses - Applied Water	379.0			461.5			449.5		
Conveyance Losses - Evaporation		207.7	207.7		248.8	248.8		245.5	245.5
Conveyance Losses - Irrecoverable Losses		0.0	0.0		0.0	0.0		0.0	0.0
Conveyance Losses - Outflow		22.9	22.9		35.4	35.4		37.9	37.9
GW Recharge Applied Water	255.5			356.6			171.7		
GW Recharge Evap + Evapotranspiration		0.0	0.0		0.0	0.0		0.0	0.0
Total Agricultural Use	**5,458.1**	**4,896.5**	**3,717.1**	**7,034.1**	**5,655.9**	**4,706.8**	**7,154.2**	**5,906.3**	**4,937.9**
Environmental									
Instream									
Applied Water	1,528.9			2,098.5			1,424.4		
Outflow		0.0	0.0		0.0	0.0		0.0	0.0
Wild & Scenic									
Applied Water	3,661.1			2,093.8			1,091.0		
Outflow		0.0	0.0		0.0	0.0		0.0	0.0
Required Delta Outflow									
Applied Water	0.0			0.0			0.0		
Outflow		0.0	0.0		0.0	0.0		0.0	0.0
Managed Wetlands									
Habitat Applied Water	414.5			444.8			414.7		
Evapotranspiration of Applied Water		105.9	105.9		149.7	149.7		136.6	136.6
Irrecoverable Losses		0.0	0.0		0.0	0.0		0.0	0.0
Outflow		134.2	1.6		128.3	1.6		135.7	1.5
Conveyance Losses - Applied Water	0.0			0.0			0.0		
Conveyance Losses - Evaporation		0.0	0.0		0.0	0.0		0.0	0.0
Conveyance Losses - Irrecoverable Losses		0.0	0.0		0.0	0.0		0.0	0.0
Conveyance Losses - Outflow		0.0	0.0		0.0	0.0		0.0	0.0
Total Managed Wetlands Use	414.5	240.1	107.5	444.8	278.0	151.3	414.7	272.3	138.1
Total Environmental Use	**5,604.5**	**240.1**	**107.5**	**4,637.1**	**278.0**	**151.3**	**2,930.1**	**272.3**	**138.1**
TOTAL USE AND LOSSES	**11,625.1**	**5,495.0**	**4,183.0**	**12,265.2**	**6,309.2**	**5,233.4**	**10,707.1**	**6,575.8**	**5,473.2**
DEDICATED WATER SUPPLIES									
Surface Water									
Local Deliveries	3,228.0	3,228.0	2,319.5	3,540.7	3,540.7	2,837.2	3,548.3	3,548.3	2,811.7
Local Imported Deliveries	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Colorado River Deliveries	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CVP Base and Project Deliveries	1,365.1	1,365.1	980.9	1,803.5	1,803.5	1,445.2	1,661.9	1,661.9	1,316.9
Other Federal Deliveries	64.3	64.3	46.2	65.8	65.8	52.7	97.6	97.6	77.3
SWP Deliveries	4.3	4.3	3.1	4.7	4.7	3.8	3.5	3.5	2.8
Required Environmental Instream Flow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Groundwater									
Net Withdrawal	831.4	831.4	831.4	892.6	892.6	892.6	1,262.6	1,262.6	1,262.6
Artificial Recharge	255.5			356.6			171.7		
Deep Percolation	684.6			1,407.1			1,444.0		
Reuse/Recycle									
Reuse Surface Water	5,190.0			4,192.3			2,515.6		
Recycled Water	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
TOTAL SUPPLIES	**11,625.1**	**5,495.0**	**4,183.0**	**12,265.2**	**6,309.2**	**5,233.4**	**10,707.1**	**6,575.8**	**5,473.2**
Balance = Use - Supplies	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*

Figure 7-5
San Joaquin River Hydrologic Region 1998 Flow Diagram
In Thousand Acre-Feet (TAF)



March 7, 2005

Figure 7-6
San Joaquin River Hydrologic Region 2000 Flow Diagram
In Thousand Acre-Feet (TAF)



November 29, 2004

Figure 7-7
San Joaquin River Hydrologic Region 2001 Flow Diagram
In Thousand Acre-Feet (TAF)